

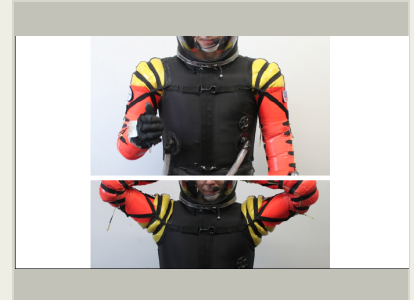
## High Performance Arm for an Exploration Space Suit, Phase I

Completed Technology Project (2013 - 2013)



## Project Introduction

Final Frontier Design (FFD) proposes to develop and deliver an advanced pressure garment arm with low torque and high Range of Motion (ROM), and increased durability, using their unique single layer approach to the pressure vessel joint. FFD has developed a flat patterned asymmetric shoulder joint for their current space suit pressure garment, with a natural position in human rest adduction, approximately -10 degrees. In addition, this joint has a focused point of rotation, like the human shoulder. Their design reduces discomfort from gathering of fabric in the armpit, provides a large ROM, favorable torque, and allows for close tracking of natural human anthropometry. In addition, FFD's elbow joint design show consistently high performance, in terms of ROM, torque, and operating pressure. This proposal also utilizes a unique approach to the pressure garment: the single layer integrated pressure garment joint as opposed to a traditional double layer bladder-restraint pressure garment. FFD's pressure garments have a host of important advantages over double layer pressure garments, including a lower mass, increased ROM, decreased torque, a thinner wall, the reduction of suit layers, the elimination of indexing, lower cost manufacturing, and flat-patterned ease of scaling and repeatability. This proposal will develop two design iterations of FFD's single layer pressure garment arm, to include both the elbow flexion-extension joint and the shoulder ad-abduction joint. The arms will be designed and tested for +8PSI operating pressure, to meet current ROM standards of NASA's pressure garments and test and increase FFD's technology cycling ability. FFD aims to increase their TRL in this project from 4 to 6 through Phase II of this contract.

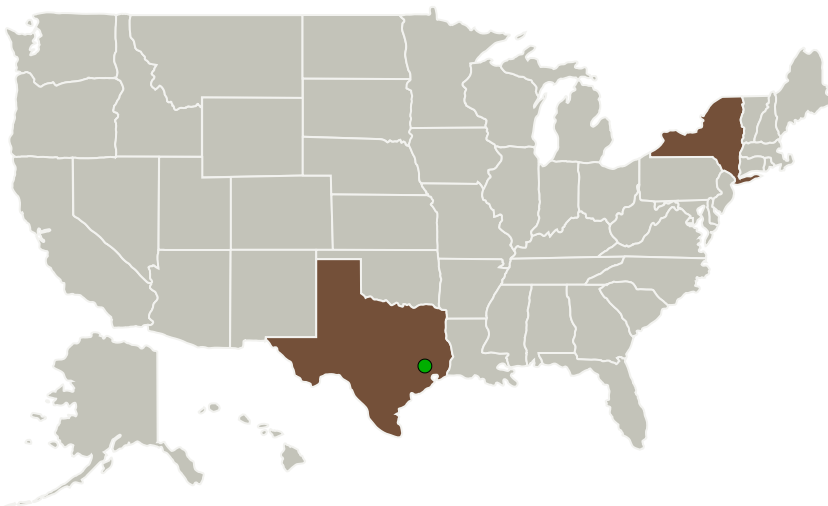


High Performance Arm for an Exploration Space Suit

## Table of Contents

Project Introduction	1
Primary U.S. Work Locations and Key Partners	1
Project Transitions	2
Images	2
Organizational Responsibility	2
Project Management	2
Technology Maturity (TRL)	2
Technology Areas	3
Target Destinations	3

## Primary U.S. Work Locations and Key Partners



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Organizations Performing Work	Role	Type	Location
Final Frontier Design	Lead Organization	Industry	Brooklyn, New York
● Johnson Space Center(JSC)	Supporting Organization	NASA Center	Houston, Texas

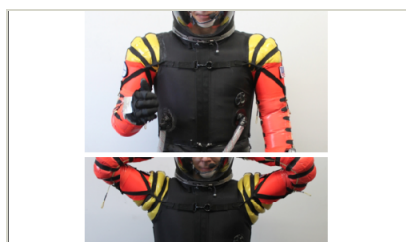
Primary U.S. Work Locations	
New York	Texas

## Project Transitions

**May 2013:** Project Start**November 2013:** Closed out**Closeout Documentation:**

- Final Summary Chart(<https://techport.nasa.gov/file/138208>)

## Images

**Project Image**

High Performance Arm for an Exploration Space Suit  
(<https://techport.nasa.gov/image/132083>)

## Organizational Responsibility

**Responsible Mission Directorate:**

Space Technology Mission Directorate (STMD)

**Lead Organization:**

Final Frontier Design

**Responsible Program:**

Small Business Innovation Research/Small Business Tech Transfer

## Project Management

**Program Director:**

Jason L Kessler

**Program Manager:**

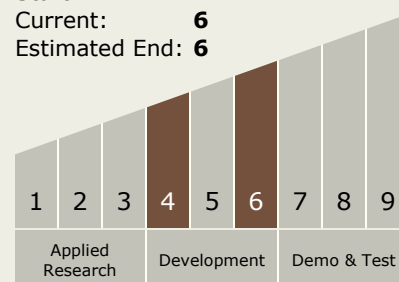
Carlos Torrez

**Principal Investigator:**

Theodore C Southern

## Technology Maturity (TRL)

Start: 4  
Current: 6  
Estimated End: 6



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## Technology Areas

### Primary:

- TX06 Human Health, Life Support, and Habitation Systems
  - └ TX06.2 Extravehicular Activity Systems
    - └ TX06.2.1 Pressure Garment

## Target Destinations

The Sun, Earth, The Moon, Mars, Others Inside the Solar System, Outside the Solar System